

March 10, 1942.

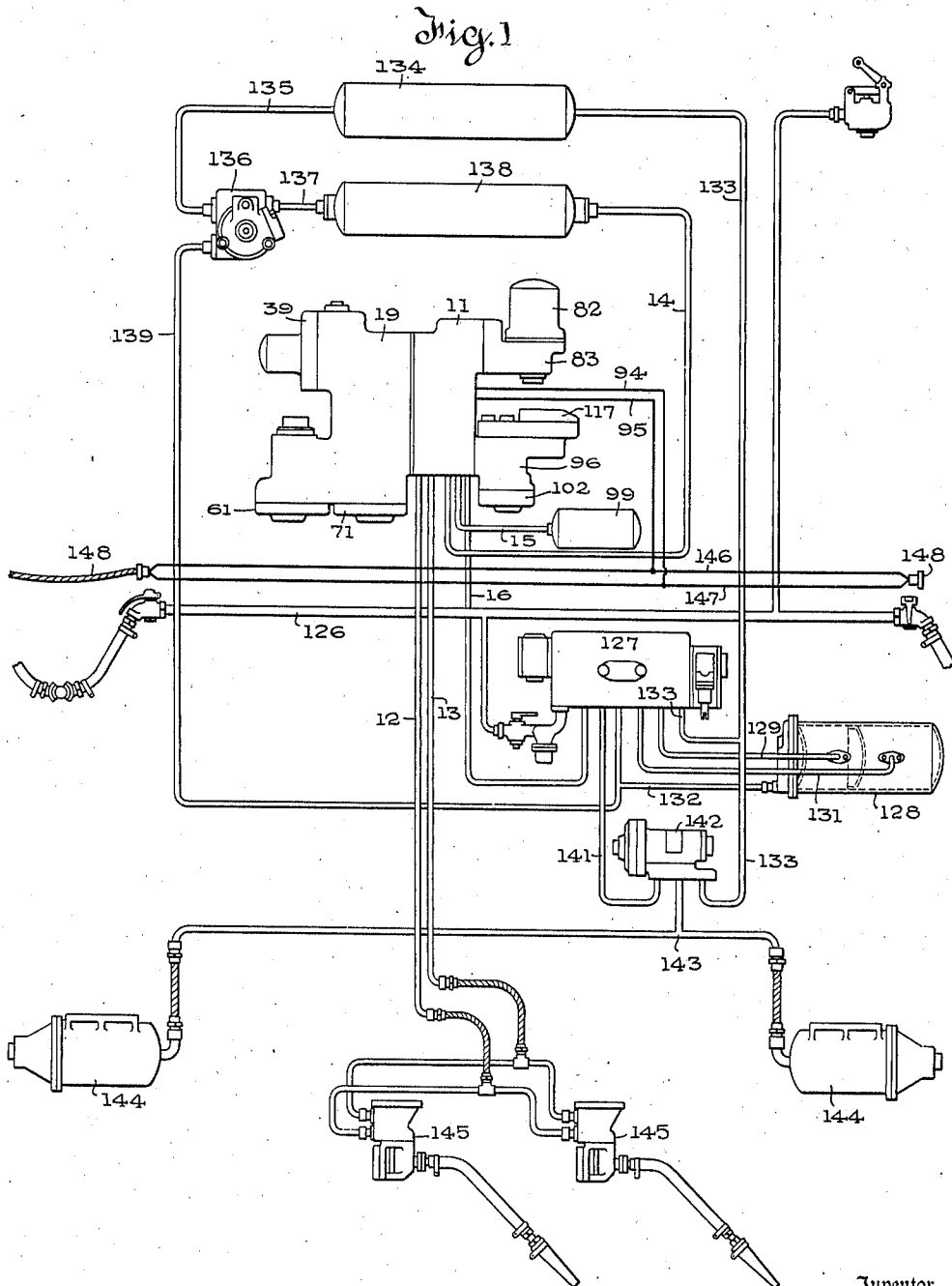
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SANDING RELAY

Filed July 10, 1941

2 Sheets-Sheet 1



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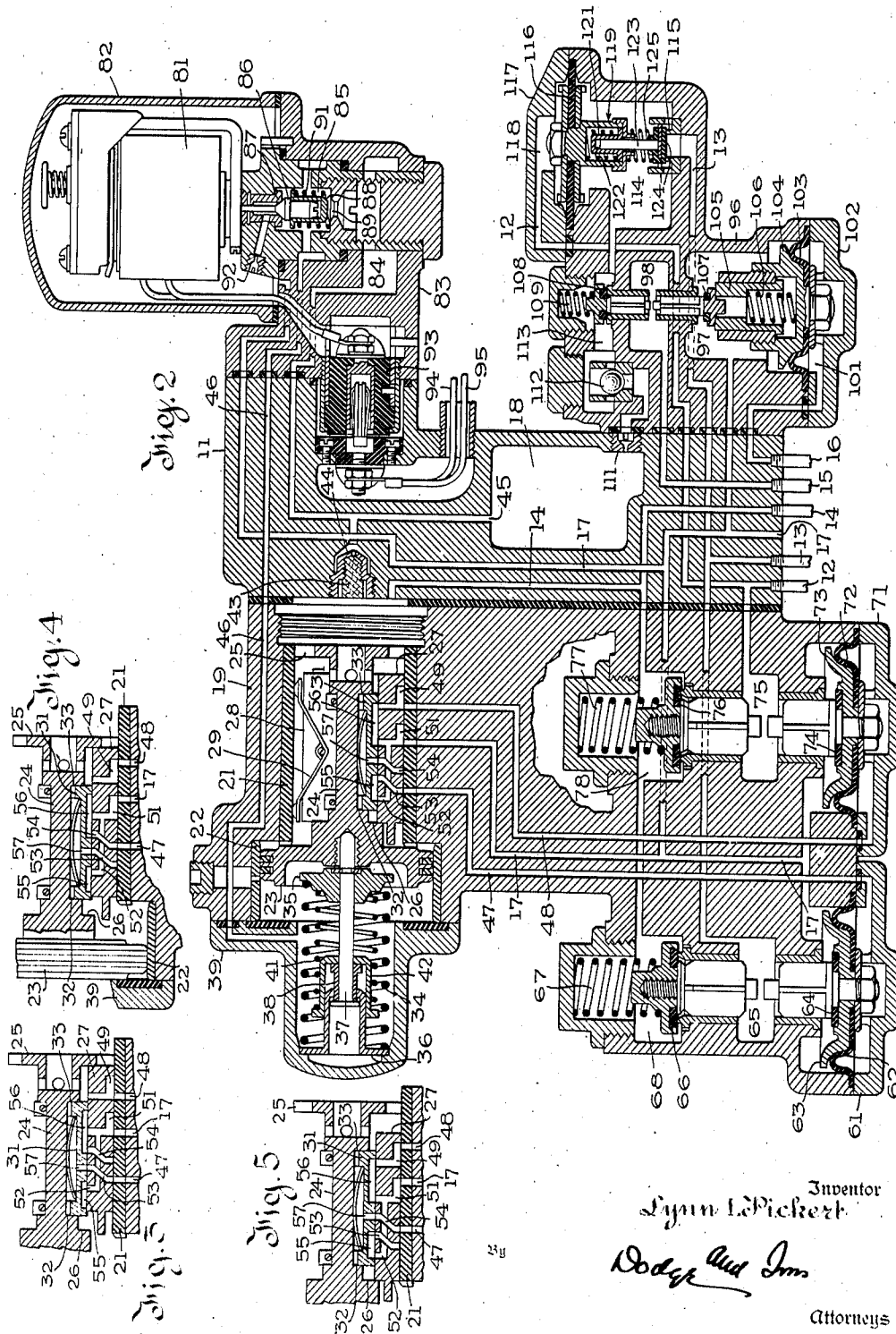
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UNITED STATES PATENT OFFICE

2,275,647

SANDING RELAY

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Application July 10, 1941, Serial No. 401,832

4 Claims. (Cl. 291—3)

This invention relates to sanders for high speed railroad trains and particularly to improvements in a relay device described and claimed in the patent to Campbell No. 2,243,244, May 27, 1941.

The relay described in the Campbell patent above identified is designed to control a sand trap having two air connections, one for sanding air and the other for cleanout air. The relay is normally inactive in a running position and as it moves towards the sanding position hesitates or dwells in an intermediate cleanout position in which it causes air to be delivered both to the sanding connection and to the cleanout connection of the sand trap which it operates.

The effect is to blow the sand delivery hose free of any obstructions so that free sanding will occur when the relay completes its full traverse and reaches sanding position. In that position the relay causes air to be delivered to the sanding connection alone, the cleanout connection being vented. On the return traverse from sanding toward running position, the relay also dwells in the cleanout position in which air is delivered to the cleanout connection alone.

The purpose of the present invention is closely related to this second dwell which, under certain circumstances, has been found to be unduly long so that compressed air is needlessly wasted in a protracted cleanout blast. The invention shortens the duration of the dwell and consequently of the cleanout blast. To understand this problem, it is necessary to explain the way in which the relay is controlled.

The Campbell patent shows two control mechanisms for the relay. One of these is an electrically actuated admission and exhaust valve which is controlled through a train circuit from the head end of the train. This electrically controlled mechanism imposes no undue delay in the final cleanout dwell. In certain instances the electrical mechanism may be omitted altogether as is fully explained in the Campbell patent. However, it is often used and will be included in the disclosure of the present application to illustrate that it may be used without interfering with the successful operation of the present invention.

The second control for the relay is a pneumatically operated admission and exhaust valve which responds to a brake applying function of the air brake system and which produces a sanding sequence in which it controls the motion of the relay from running position to sanding position and back to running position within a time period whose duration is determined by the vol-

ume of a timing reservoir. Where the relay is used merely to produce a preliminary and very brief sanding sequence, as is the case in the preferred embodiment described in the Campbell patent, the volume of the timing reservoir is small and hence exercises no seriously disturbing effect on the final cleanout dwell of the relay, but where this relay is used to produce sanding cycles of considerable duration, say ninety seconds, as is also proposed in the Campbell patent, the volume of the timing chamber is much larger, and when added to the volume of the delay chamber which forms a part of the relay increases unduly the second or final cleanout dwell of the relay.

The purpose of the present invention is so to relate the timing chamber to the relay mechanism that the timing chamber is allowed to perform its normal function in limiting the overall duration of the sanding cycle without materially increasing the final cleanout dwell of the relay. Advantage is taken of the fact that when the relay is moving outward toward sanding position the dwell occurs when both the sanding and the cleanout connections are in communication with the air supply, whereas, in the second dwell, which occurs when the relay is moving from sanding toward running position, the sanding connection is vented and the cleanout connection alone is connected to supply. Thus the relay has an asymmetric characteristic and this is availed of to isolate the timing reservoir from the delay chamber and charge the timing reservoir fully, with the result that the delay chamber alone times the dwell in essentially the same way that it times the dwell under electric control.

The invention will now be described by reference to the accompanying drawings in which:

Fig. 1 is a diagram of the braking and sanding equipment for one car of a train.

Fig. 2 is a diagrammatic section of the relay valve including its electrical and pneumatic controls. (The parts are shown in running or inactive position.)

Figs. 3, 4 and 5 are diagrams of the slide valve components of the relay showing respectively preliminary cleanout position, sanding position, and final cleanout position.

It may be remarked that Fig. 1 shows a car equipment similar to that of Fig. 2 of the Campbell patent and thus represents the equipment for cars other than the motor car.

The system can be controlled by mechanism such as that shown in Fig. 1 of the Campbell patent; it can be controlled as indicated in Fig. 9 of the Campbell patent, and in fact is available

for use generally wherever the structure of the Campbell patent might be used and with improved results.

The sand trap with which the relay is intended to be used is shown in the Campbell Patent No. 2,243,243, and an examination of this patent will give a full understanding of the cleanout and sanding characteristics of such a trap.

Refer first to Figs. 2 to 5 inclusive, which views are diagrams to the extent that the ports are drawn as if they all lay in a common plane which is the plane of section.

The entire relay is carried on a pipe bracket 11 which is supported on the car and to which all pipe connections are made. The sanding air line appears at 12, the clean-out air line at 13, the sanding supply reservoir connection, which furnishes all operating air, at 14, and the timing reservoir connection at 15. The connection 16 is from the sanding port of the control valve, as will be explained, and is the connection through which the relay is put into action by emergency response of the control valve. Leading from the connections 12 to 16 inclusive are freely communicating passages formed in the bracket and in the connected housings. For the purpose of reducing the number of reference numerals and simplifying the tracing of ports, these interconnected ports and pipes are considered as forming continuous passages and are given a single reference numeral. In addition to the passages which form continuations of the pipes 12 to 16 inclusive, the bracket and connecting housings are formed with an exhaust port 17, and the bracket 11 encloses a chamber 18 which participates in a timing function hereinafter described.

Mounted on one side of the bracket 11 is a housing 19 which encloses the pilot slide valve mechanism of the relay as well as the piloted poppet valves. In the upper portion of the housing 19 are mounted a slide valve chamber bushing 21 and a cylinder bushing 22. Working in the cylinder 22 is a piston 23 which has a stem 24 extending into the slide valve chamber within bushing 21 and terminating in the spider 25 which guides the stem. Mounted for lost motion between the shoulder 26 adjacent the piston and the spider 25 is the main slide valve 27. This has wings 28 which straddle the piston stem 24 and which carry a bow spring 29 arranged to hold the valve 27 against its seat. Between the wings 28 the back of the slide valve 27 is formed with a seat for a graduating slide valve 31, which is closely confined between the shoulders 32 and 33 on stem 24 so that the graduating valve partakes of all of the movements of the piston 23.

Piston 23 is urged to the right by a duplex spring assembly so arranged that only one of its two concentric springs resists the motion of the piston to the left through that part of its travel corresponding to the lost motion of the piston relatively to the main slide valve 27. At the limit of such motion both springs oppose motion of the piston.

The main or primary spring is shown at 34 and is confined under stress between an inner spring seat 35 and an outer cupped spring seat 36. These two spring seats are connected together by a headed stem 37 which is slidable through a bushing 38. This in turn is slidable axially through the spring seat 36 for a limited range corresponding to the lost motion just mentioned. The spring seat 36 seats within the end of a closure cap 39 which closes the outer end of the cylin-

der 22. The cap is sealed by a gasket, as shown, and the gasket projects inward far enough to serve as a seat for the piston when the latter arrives at the outer limit of its motion.

The secondary spring 41 is a lighter spring mounted concentrically within the spring 34. It is sustained at its inner end on the spring seat 35 and is sustained at its outer end on the cupped spring seat 42, which is thimble-like in form, engages the end of bushing 38 and telescopes over the spring seat 36. Its telescoping motion is limited by the bushing 38. The action is as follows: When the piston 23 moves outward, it is opposed initially by the spring 34 until the spider 25 engages the slide valve 27 and is about to move it. At this point bushing 38 and spring seat 42 reach their limit of motion. From then on the resistance of the inner spring 41 is added to that of the spring 34. The purpose is to cause the piston to pause momentarily at the limit of motion of the graduating valve 31 relatively to the slide valve 27. This effect is had in both directions of motion.

The space within valve chamber bushing 21 and to the right of the piston 23 is in free communication with the sanding reservoir passage 14. It is also in communication, by way of filter 43 and choke 44, with a passage 45 in bracket 11 which communicates with the chamber 18 already described. From the space within the cap 39 to the left of piston 23, a passage 46 leads through the body 19 and bracket 11, as shown.

In the seat on which the main slide valve 27 is mounted are three ports; a cleanout air control port 47, a branch of the exhaust port 17, and a sanding air control port 48. In the valve 27 and communicating with the port 48 in all positions of the slide valve is a through port 49. An enlargement at the bottom of the port 49 is the means to maintain communication between it and the port 48 in all positions of the slide valve 27. Also formed through the slide valve 27 is a port 51 which is enlarged at its bottom so that it communicates with the exhaust port 17 in all positions of the slide valve. This port has an extension 52 leading outward and thence to the graduating valve seat in the back of the slide valve. In addition there are two impulse ports 53 and 54 which lead through the slide valve.

The graduating valve has two cavities in its lower face, namely 55 and 56, and has drilled through it an impulse port 57.

These ports are so arranged that in the normal or running position of Fig. 2 cleanout control port 47 is connected to exhaust port 17 by way of port 53 and cavity 55, port 52 and port 51. At the same time the sanding air control port 48 is connected to exhaust port 17 by port 49, cavity 56 and port 51, and port 57 communicates with the port 54 which is then blanked at the seat.

When the piston starts outward the graduating valve 31 exposes port 49 at the same time that port 57 opens to port 53 and the ports are fully open at the limit of lost motion of the graduating valve relatively to the slide valve. The effect is to admit air under pressure from the sanding supply reservoir to both the ports 47 and 48 (see Fig. 3).

The remaining movement of the piston 23 outward moves the slide valve and carries port 53 out of register with port 47, cutting off the flow of air to port 47 and causing port 54 to register with port 47 (see Fig. 4).

On the return excursion the graduating valve

first closes the port 49 and then the port 57 registers briefly with the port 54 (see Fig. 5) to furnish a brief cleanout blast to the port 47. As above set forth, the piston pauses momentarily in the position of Fig. 5 because at this point the spring 41 reaches its limit of expansion. Continued movement carries the slide valve inward so that port 54 moves out of register with port 47. When running position (Fig. 2) is reached, both ports 47 and 48 are vented to atmosphere by connection with port 17 as already described.

Mounted in the lower part of the housing 19 are two poppet valve mechanisms which are controlled by the admission and exhaust of pressure fluid to and from the ports 47 and 48 respectively.

Port 47 leads to the space within the cap 61 and beneath the flexible diaphragm 62, the diaphragm being clamped at its periphery between the cap 61 and the housing 19 and connected at its center to a thrust plate 63 which carries an exhaust poppet valve 64. The space immediately above the diaphragm 62 is connected to atmosphere by way of port 17.

When the diaphragm is in its normal lower position the valve 64 is open and connects the chamber 65, to which the cleanout air line 13 leads, with atmosphere. When pressure fluid is admitted beneath diaphragm 62 the effect is to force the valve 64 upward, closing the exhaust passage. A lug on the end of the valve 64 strikes a similar lug on the lower end of a poppet valve 66 and unseats this valve against the opposition of a coil compression spring 67 and the fluid pressure communicated from the sanding supply reservoir line 14 to the chamber 68 above the poppet valve 66.

Similarly, the sanding control port 43 leads to the space within cap 71 and beneath flexible diaphragm 72. This is clamped at its periphery between the cap 71 and the housing 19 and is clamped at its center to the thrust plate 73, to which the exhaust valve 74, similar to the valve 64, is attached. The chamber 75 is connected to the sanding air line 12 and the valve 74 carries a lug which, when the valve is forced closed, strikes a similar lug on the inlet valve 76 and forces it upward against the resistance of the coil compression spring 77 and the pressure communicated to the chamber 78 by the sanding supply passage 14.

Thus the two passages 12 and 13 are normally vented to atmosphere by the poppet valves 64 and 74. If the port 47 is put under pressure, the exhaust passage is closed and a direct connection is open past supply valve 66 to the passage 13. Similarly, if the passage 43 is under pressure, the exhaust passage past the valve 74 is closed and the valve 76 is unseated to admit air from the sanding reservoir connection directly to the sanding connection 12. In this way a relatively small slide valve mechanism, with ports of comparatively small size, pilots the action of inlet and exhaust mechanisms of large capacity.

Electric control is exercised by energizing and deenergizing a winding 81 which is mounted under a cap 82 on a valve body 83 bolted to bracket 11. In the housing 83 is a chamber 84 which is in free communication by way of port 45 with the chamber 18 already described. The port 46 leading from the space to the left of piston 23 terminates in valve chamber 85. In the chamber 85 is a double beat poppet valve having an exhaust head 86 which coacts with an atmospheric exhaust seat 87 and an inlet head 88 which co-

acts with the supply seat 89 controlling flow between the chambers 84 and 85.

A coil compression spring 91 urges the poppet valve toward the exhaust seat. When the winding 81 is de-energized, as it is under running conditions, the exhaust head 86 of the double beat valve seals on seat 87 and the port 46 is connected by way of chamber 84 and port 45 with the chamber 18, and further by way of choke 44 and filter 43 with the slide valve chamber within bushing 21. As explained, this chamber is in free communication with the sanding supply reservoir line 14. Thus, under normal conditions, the pressures on the two sides of the piston 23 equalize and the springs force the piston 23 to its innermost or right-hand position, shown in Fig. 2.

If the winding 81 is energized, the double beat poppet valve is moved downward, isolating chamber 85 from chamber 84 so the chamber 18 remains charged, and connecting chamber 85 with atmosphere through a flow controlling choke 92. It follows that the space to the left of piston 23 is vented to atmosphere at a rate controlled by the flow capacity of choke 92. The piston moves outward against the resistance of spring 34 and just at the limit of lost motion between the piston and the main slide valve 27 the resistance of the second spring 41 is added, so that the piston pauses momentarily in that position and then resumes its outward excursion until it seals on the cap gasket. This is sanding position.

When the winding 81 is de-energized, the double beat poppet valve 86, 88 will return to the position shown in Fig. 2, closing the exhaust from chamber 85 and connecting chamber 85 with chamber 84 and chamber 18. The resulting increase of pressure on the outer face of piston 23 will start the return excursion of the piston. Under these conditions the choke 44 will exert control on the rate of development of pressure on the left side of piston 23 and consequently on the rate of inward motion of the piston.

The structure indicated at 93 is merely a separable connector for the leads 94 and 95, which are connected with the terminals of the winding 81.

Bolted to the bracket 11 is a housing 96 which contains a chamber 97 connected to the exhaust passage 17, and a chamber 98 connected to the timing reservoir connection 15. A timing reservoir is indicated at 99 in Fig. 1 and augments in any desired degree the volume of chamber 98. The connection 16 leads to a chamber 101 within the cap 102 and below a diaphragm 103. This is clamped at its periphery between body 96 and cap 102 and is connected at its center to the thrust plate 104. Slidably mounted within the thrust plate 104 and limited in its outward motion by a stop flange is a plunger 105 which is urged outward by the coil compression spring 106. When the diaphragm 103 is forced upward, plunger 105 reacts against an exhaust poppet valve 107 to urge it in an exhaust closing direction. The pilot of the exhaust valve 107 is in position to collide with the pilot of the reversely seated poppet valve 103, which is urged closed by a coil compression spring 109 and which controls flow from the chamber 18 previously described to the chamber 98 and connected timing reservoir 99. The flow is by way of a choke 111 and ball check valve 112 to the chamber 113 behind the valve 103.

The device so far described is the Campbell sander relay as disclosed in the patent above identified. To limit the dwell in the final clean-

out position, the diaphragm valve unit now about to be described is added in an extension of housing 96.

A chamber 114 in free communication with chamber 113 contains a valve seat 115, to which a branch of the cleanout air passage 13 leads. The upper wall of chamber 114 is a flexible diaphragm 116 confined at its margin by cap 117, so that there is a chamber 118 above the diaphragm. A branch of sanding passage 12 leads to chamber 118.

A hub structure 119 is carried by the center of diaphragm 116. In this is guided a bushing 121 urged downward by a spring 122. Slidable with limited lost motion in bushing 121 is the stem 123 of poppet valve 124 which coacts with seat 115. A spring 125 reacts between hub 119 and valve 124.

The area of diaphragm 116 greatly exceeds the area of valve 124 so that when chamber 118 is under pressure valve 124 will be held closed.

The connection 16 leads from the sanding port of the brake controlling valve device and when pressure is developed in connection 16 the diaphragm 103 moves upward, forcing the valve 107 closed and the valve 108 open. The effect is to reduce the pressure in the chamber 18 and since this is normally connected by way of port 45, chamber 84, chamber 85 and port 46, with the space to the left of the piston 23, the resulting reduction of pressure in chamber 18 causes the piston 23 to move outward.

The reduction of pressure will continue until timing reservoir 99 is charged nearly to equalization with the sanding supply passage 14. Choke 44 feeds to chamber 18 at a rate less than the outflow through the larger choke 111, at least until reservoir 99 is nearly charged. Ultimately, development of pressure in chamber 18 would cause piston 23 to move inward and terminate sanding. This would occur after an appropriate interval, say 90 seconds.

On outward motion of piston 23 there will be a dwell in the position of Fig. 3. In this position sanding air connection 12 and cleanout air line 13 are both under pressure. Hence diaphragm 116 is subject to pressure in line 12 so that valve 124 is held closed. It is similarly held closed in full sanding position of Fig. 4.

Charging of the timing reservoir will proceed, and as in the Campbell device, a stage will be reached when piston 23 moves into the position of Fig. 5. In this position the sanding connection 12 is vented venting chamber 118 above diaphragm 116 so that pressure in chamber 114 forces diaphragm 116 up and opens valve 124. This permits cleanout air to flow from connection 13 which is connected to supply, to chamber 114. This quickly charges timing reservoir 99 and closes valve 112. Hence the dwell in Fig. 5 is timed solely by chamber 18 and is of the short duration characteristic of the electric control already described.

Reference will now be made to Fig. 1. The brake pipe appears at 126 and would be connected from car to car in a train by flexible hose with couplings and angle cocks shown in the drawing, all in accordance with the conventional practice. The brake pipe 126 is connected through the usual cut-out cock and dust collector with the brake controlling valve device 127, here assumed to be a control valve of the D-22 type. Such valves may be used either in an automatic or combined straight air automatic system but for

purposes of explanation a simple automatic system is assumed.

The control valve 127 has three connections to chambers in a multi-chambered reservoir 128. These connections are the auxiliary reservoir connection 129, the emergency reservoir connection 131, and the displacement volume connection 132. The brake pipe 126 is normally under pressure (say 110 lbs. per sq. in.) and the control valve 127 functions in release position to charge the auxiliary and emergency reservoirs and also to deliver air to a supply reservoir connection 133 which is in communication with the supply reservoir 134.

From the reservoir 134 the pipe 135 leads to the intercepting valve 136 and from the intercepting valve 136 another pipe 137 leads to the sander supply reservoir 138 to which the pipe 14 already mentioned is connected. The intercepting valve is controlled by pressure in the pipe 139 in such a way that when the pipe 132 is under pressure, as it is during a brake application, the reservoir 138 cannot draw on the reservoir 134 for air. Thus the brake supply reservoir is protected against depletion of charge by demands of the sanding system, as soon as a brake application commences. The structure of the intercepting valve 136 is not shown but it is fully disclosed in the Campbell patent, above identified.

The control valve 127, in response to a reduction of brake pipe pressure will establish related pressure in the pipe 141 leading to the admission and exhaust relay valve 142. The relay valve functions to establish proportionate pressures in the pipe 143 and in the connected brake cylinders 144. The relay 142 is supplied with air from the reservoir 134 through the pipe 133.

A pair of sand traps 145 are shown and are illustrated as connected to the sanding air connection 12 and the cleanout air connection 13 in the usual manner. The pipe 16 leads from the sander control connection of the control valve 127 and is connected to the sanding relay as already described. The control valve 127 may put the sanding connection 16 under pressure in emergency application or in both service applications and emergency applications, so far as the present invention is concerned.

The winding 81 in the housing 82 is connected across electrical train circuits 146, 147. These are connected from car to car by jumpers 148 in the usual manner. The electrical controlling mechanism may be actuated in any known way, for example, it may be operated from the head of the train as proposed in the Campbell patent, above identified. Furthermore, the electrical mechanism can be wholly omitted, in which event the relay would be operated pneumatically under the control of the mechanism in the housing 96. As explained, a long timing cycle requires a large volume for the timing reservoir 99 and where the timing cycle is long, the volume of the timing reservoir 99 added to the volume of the delay chamber 18 permits too long a dwell in the final cleanout position of Fig. 5.

The effect of applicant's invention is to isolate the reservoir 99 and charge it fully as soon as the relay arrives in the position of Fig. 5, so that the excess dwell is not imposed but on the contrary the control is determined solely by the volume of the delay chamber 18.

As pointed out in the Campbell patent above

identified, a sanding operation initiated by the mechanism in the housing 96 cannot be terminated short of its time period, by operation of the electrical mechanism controlled by the winding 81. However, it can be prolonged by that mechanism.

While the relay has been described in considerable detail and while references have been made to a particular type of sand trap and a particular arrangement or interconnection of the sanding and braking system, it should be understood that this is intended to be illustrative and not limiting. The invention is useful with any timing relay having similar characteristics of timing control, and in which the timing is effected by a timing reservoir and a delay chamber according to the general principles above set forth.

I claim:

1. In a sanding relay unit, the combination of a housing enclosing a slide valve chamber and communicating cylinder; means for supplying air under pressure to said slide valve chamber; a piston working in said cylinder and separating the slide valve chamber from a working space in said cylinder; a slide valve and coacting graduating valve connected to be actuated by said piston, said valves controlling sanding and cleanout ports, there being a running position at the limit of piston motion inward toward the valve chamber in which both ports are vented, a sanding position at the outward limit in which the sanding port is under pressure and the cleanout port vented, a cleanout intermediate position assumed in outward motion in which both said ports are under pressure and a cleanout intermediate position assumed in inward motion, in which the cleanout port is under pressure and the sanding port vented; loading means for biasing said piston and valves toward running position and for causing them to dwell in said intermediate positions; a delay chamber forming an enlargement of said working space; means affording restricted communication between the delay and slide valve chambers; a delay suppression chamber in somewhat less restricted communication with said delay chamber; a check valve controlling the last named communication and inhibiting flow toward the delay chamber; a timing chamber; valve means normally serving to vent the timing chamber and operable to close said vent and connect the timing and delay suppression chambers; and delay suppression means responsive to venting of the sanding port while the cleanout port is under pressure and serving when so rendered active to

charge the delay suppression chamber and timing chamber.

2. The combination defined in claim 1 in which there are pressure operated supply and exhaust valves respectively operated to supply position by development of pressure in said sanding and cleanout ports, said pressure operated valves thus supplying sanding air and cleanout air under the control of the slide valve; and the delay suppression means comprises a valve biased in an opening direction by the pressure of cleanout air and a related and larger movable abutment biased in a valve closing direction by the pressure of sanding air.

3. In a sanding relay unit, the combination of a housing enclosing a slide valve chamber and communicating cylinder; means for supplying air under pressure to said slide valve chamber; a piston working in said cylinder and separating the slide valve chamber from a working space in said cylinder; a slide valve and coacting graduating valve connected to be actuated by said piston, said valves controlling sanding and cleanout ports, there being a running position at the limit of piston motion inward toward the valve chamber in which both ports are vented, a sanding position at the outward limit in which the sanding port is under pressure and the cleanout port vented, a cleanout intermediate position assumed in outward motion in which both said ports are under pressure and a cleanout intermediate position assumed in inward motion, in which the cleanout port is under pressure and the sanding port vented; loading means for biasing said piston and valves toward running position and for causing them to dwell in said intermediate positions; a delay chamber forming an enlargement of said working space; means affording restricted communication between the delay and slide valve chambers; a timing chamber; valve means normally serving to vent the timing chamber and operable to close said vent and establish a restricted one-way flow connection from the delay chamber to the timing chamber; and pressure operated delay suppression means rendered effective by charging of the cleanout port while the sanding port is vented to charge said timing chamber.

4. The combination defined in claim 3 in which the delay suppression means comprises a valve biased in an opening direction by pressure of cleanout air and a related and larger movable abutment biased in a valve closing direction by pressure of sanding air.

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